The SrTiO3 displacive transition revisited by Coherent X-ray Diffraction

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Although most issues concerning the application of the scaling theory of phase transitions have been settled long ago, two frequently observed scattering features remain unaccounted for within standard scaling theory: the "neutron" central peak (CP) and the "x-ray" narrow component (NC). Remarkably, both features were first evidenced in studies of the critical behavior associated with the T_c ~100-105 K antiferrodistortive transition in the perovskite $SrTiO_3$. We present a Coherent X-ray Diffraction study of the antiferrodistortive displacive transition of $SrTiO_3$. From the microbeam x-ray coherent diffraction patterns, we show that the broad (short-length scale) and the narrow (long-length scale) components can be spatially disentangled. Moreover, both components exhibit a static speckle pattern. This gives evidence that the narrow component corresponds to static ordered domains. We interpret the speckles in the broad component as due to a very slow dynamical process, corresponding to the well-known central peak seen in inelastic neutron scattering. Beyond this experiment, we show that CXD is a valuable new tool to study phase transitions and defects in the low temperature ordering.

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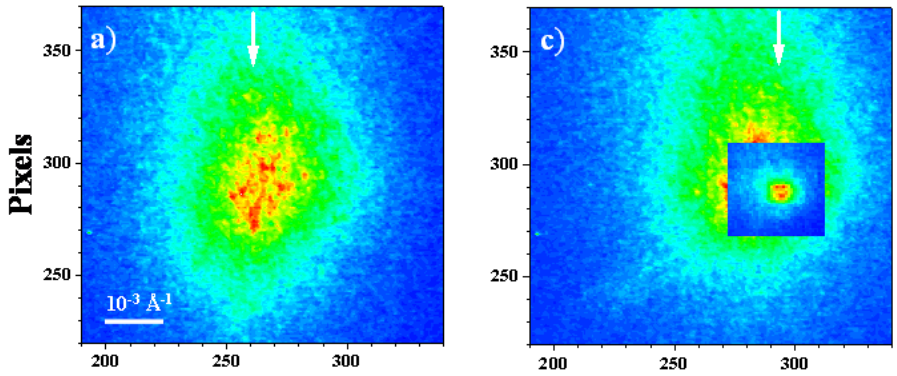

2D pattern of the (3/2,1/2,1/2) superstructure reflection at two different positions of the beam. Broad and narrow components can be disentangled by μ-beam. On both components static speckles are observed on a ~10 mn time scale.